

# The Validity and Status of the Roundscale Spearfish, *Tetrapturus georgei*<sup>1</sup>

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## ABSTRACT

A fourth Atlantic species of the istiophorid genus *Tetrapturus* was discovered in 1961 among commercial catches landed in Sicily, Portugal, and Spain. Subsequent efforts to obtain information have failed because the fishermen do not distinguish the species and it is apparently much less common than *T. belone* in Sicily and *T. albidus* in Spain and Portugal.

The species is described in detail. Important distinguishing features are: the form of the scales on the midside, the shape of the lobes of the spinous dorsal and anal fins, the position of the anus, and the pectoral-fin length.

The nomenclatural validity of *Tetrapturus georgei* Lowe is discussed and reasons are given for applying this name to the newly discovered species.

In 1961 the author traveled to Sicily, Portugal, and Spain to study 95 specimens of istiophorid fishes that had been purchased and retained in commercial freezers for the purpose. Of 36 specimens examined in Sicily, 35 were Mediterranean spearfish, *Tetrapturus belone* Rafinesque, and these formed the basis for the redescription of the species by Robins and de Sylva (1963). Of the remaining 59 specimens, 56 were white marlin, *Tetrapturus albidus*, which formed the basis of reports by Rodriguez-Roda and Howard (1962) and Robins (1974). Four specimens represented an unknown species of *Tetrapturus*, whose presence had been unsuspected.

Based on a study of this material, Robins prepared and distributed a two page mimeographed leaflet requesting additional records and data. Inasmuch as the fishermen have never clearly distinguished the Mediterranean spearfish and the white marlin, it is not surprising that this additional spearfish should go undetected and no additional data have been forthcoming.

This report describes the species here called the roundscale spearfish, and the scientific name *Tetrapturus georgei* Lowe is applied to it in lieu of proposing a new name for it.

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## TETRAPTURUS GEORGEI LOWE

### Roundscale spearfish

*Nomenclature.* Lowe (1840:36-37) did little more than announce his intention to describe a new species of *Tetrapturus* by which he would commemorate "by its specific name the valuable assistance rendered to the cause of ichthyology by Mr. George Butler Leacock." The only data are: 1) that the specimen was from Madeira; 2) that its pectoral fin was proportionally twice as long as in the description of *T. belone* by Valenciennes, in Cuvier and Valenciennes (1831), and that its body was "clothed with large scales of a peculiar shape and nature." No additional data were ever published, later accounts (Lowe, 1841:93; 1849:3) merely repeating the original. This was discussed by Robins and de Sylva (1960:397-398) who stated "The identity of *T. georgei* Lowe. . . will probably never be solved."

The discovery of an additional species from near Madeira requires reassessment of *T. georgei*. Beyond the three points of fact mentioned above, the matter becomes an exercise in logic. Even the matter of the scales involves interpretation.

Including the roundscale spearfish, as many as six species of Istiophoridae might occur in the vicinity of Madeira at least occasionally. According to Maul (in litt.), istiophorids are rare at Madeira and only

appear during the summer. The white marlin, *T. albidus*, is likely the most abundant, as is supported by data in Ueyanagi et al. (1970) and Robins (1974). Moreover, a photograph sent by Maul in 1961 was identified by Robins as that of a white marlin. (This and other photographs were destroyed in a fire in 1967, but a surviving letter from Howard to Maul, 3 March 1961, discussed this photograph in detail.) This species has long pectoral fins in adults, 19-27 percent of body length for eastern Atlantic specimens vs. 10-13 percent of body length in adults of *T. belone* (Robins and de Sylva, 1963, Table 4), these data agreeing well with point two in Lowe's description. Valenciennes, in Cuvier and Valenciennes (1831), made no mention of scales in *T. belone* and thus there is no solid basis for judging Lowe's use of "peculiar." Compared to the naked *Xiphias* or to more typical fishes, the long needle-like scales of most istiophorids are indeed peculiar. *T. albidus* is unique in the family for the unblemished record of its specific name. It has always gone under Poey's name, although for many years it was referred to as *Makaira* and by some authors as *Lamontella* before Robins and de Sylva (1960) returned it to *Tetrapturus*. If it is judged that *T. georgei* is most likely the white marlin, the author would petition the International Commission of Zoological Nomenclature to reject the earlier name *T. Georgii* Lowe and preserve the well known junior name *T. albidus* Poey for this important game and food fish.

The roundscale spearfish as noted below occurs in the eastern Atlantic, not far from Madeira, as well as in the Mediterranean. No doubt it reaches Madeira and many, if not all, of the eastern North Atlantic records of *T. pfluegeri* in Japanese literature (Ueyanagi et al., 1970) may be referable to it. Its pectoral-fin length varies from 20-26 percent of body length, also agreeing with Lowe's value. Its scales along the sides are rounded with posterior spikes, thus being less specialized than other istiophorid fishes. Whether these less modified scales are more "peculiar" depends on one's viewpoint. *T. georgei* easily could apply to this species which otherwise has no scientific name. In the interests of avoiding the need for a new name in a family with a cluttered nomenclatural history and in the interest of avoiding any possibility of applying *T. georgei* to *T. albidus* the author here restricts the name *T. georgei* to the roundscale spearfish.

Other species of Istiophoridae are judged to be less likely candidates. *T. pfluegeri* also has a long pectoral fin in adults (19-22 percent of body length)

though not so long as in the two species already discussed. Further, its occurrence as far east as the Azores (Ueyanagi et al., 1970: Fig. 7) may in fact be based on the roundscale spearfish. The sailfish, *Istiophorus platypterus* Shaw and Nodder, has a short pectoral fin in the small-sized Atlantic fishes (14-19 percent of body length), and its remarkable dorsal fin surely would have elicited a comment from Lowe. The blue marlin (*Makaira nigricans*) is rare in the eastern North Atlantic but does occur at Madeira. G.E. Maul, in a letter (24 February 1961) to John K. Howard, refers to istiophorids in excess of 1,000 lb. These could be nothing else but blue marlin. This species has a fairly long pectoral fin (adults of Atlantic fish usually 18-24 percent of body length). The Mediterranean spearfish, *T. belone* Rafinesque, is not known to occur outside of the Mediterranean but may do so. It, of course, was the fish Lowe used as a basis of comparison and it has a short pectoral fin as already noted. Perhaps the most decisive statement that can be made of *T. georgei* is that it is not *T. belone*, and that authors like Albuquerque (1956), who treated it as a synonym of *T. belone* and thus extended the range of *T. belone* to Madeira, were in error.

*Synonymy.* *Tetrapturus Georgii* Lowe, 1840:36-37 (original description; type locality: Madeira) 1841:93; 1849:3 (original account repeated).

*Tetrapturus georgei* Robins and de Sylva, 1960:397-398 (name discussed, regarded as unidentifiable).

No other name has ever been applied to the species although the reference by Rodriguez-Roda and Howard (1962:495) to two unidentified specimens under study by Robins refers to this species.

The name is here modified to *Tetrapturus georgei* for reasons discussed by Bailey et al. (1970:5).

*Taxonomy.* The roundscale spearfish is referred to *Tetrapturus* Rafinesque (1810:51-55; type species *T. belone* by monotypy) as defined by Robins and de Sylva (1960:403-404 and in key).

Lowe's specimen of *T. georgei* and his notes on it were apparently destroyed. Lowe perished in a shipwreck in the Bay of Biscay in 1874, and it is said that he had a large collection of Madeiran specimens and his manuscripts with him.

*Diagnosis.* Scales on sides of body round anteriorly usually with two or three posterior projections, the scales only slightly imbricate and soft. Scales dorsally and ventrally elongate imbricate and stiff, more typical of the Istiophoridae. Anterior lobe

of spinous dorsal and anal fins rounded. Spinous dorsal fin high, unspotted. Nape moderately humped. Anus moderately far from anal-fin origin, the distance between them equal to about one-half the height of the first anal fin. Pectoral fin long in adults, subequal to pelvic fins, reaching beyond curve of lateral line. Isthmial groove present. Eye moderate about 2.9 percent of body length. Vertebrae: 12 precaudal plus 12 caudal. First dorsal-fin elements: 43-48.

*Material examined.* CRR-Med-1, male, fairly large but not in spawning condition, 1,600 mm body length, 21.5 kg, Sicily, near Messina, 2 August 1961 (specimen not retained). CRR-EAtl-1, female (no well developed ova), 1,570 mm body length, 20 kg, Portugal, trap off Faro, Cape Santa Maria, 27 May 1961 (piece of skin and pectoral girdle catalogued as UMML 11076). CRR-EAtl-2, female (no well developed ova), specimen broken, no measurements recorded, 23.5 kg, Portugal by longline off Cape Santa Maria, 9 August 1961. CRR-EAtl-3, female (no well developed ova), 1,540 mm body length, 23.5 kg, Strait of Gibraltar, 5 October 1961.

Robins and de Sylva (1960:405-406) presented a key to the known species of Istiophoridae. At that time *T. pfluegeri* had not been distinguished from *T. belone* and the reference in the key to *T. belone* in fact refers to *T. pfluegeri*. Table 1 contrasts the four Atlantic species of *Tetrapturus*.

*Taxonomic status.* *T. georgei* is easily separable from other species in the genus by the characters given in the diagnosis and in Table 1. Although in some features it is intermediate between *belone* and *albidus*, it is extreme or unique in others so that it can not be a hybrid between them (see below). With so few specimens examined little can be said of variation and certainly nothing is known of its population structure.

*Common names.* Roundscale spearfish is proposed as the English common name for the species in recognition of its peculiar lateral scales. Lowe (1840) referred to it as peito. Albuquerque (1956) and others have used peto, but they have failed to distinguish istiophorid species, and peito or peto may be taken as comparable to the more general English word billfish rather than as a name for any one species.

*Morphology.* Morphometric data are presented in Table 2. Fin-ray counts are (in each instance the order of presentation is Med-1, EAtl 1, 2, 3): first dorsal 48, 45, 47, 43; second dorsal -, 7, 6, 6; first anal 16, 14, 15, 16; second anal -, 5, 7, 6; pectoral 19, 20,

20, 19. There were 12 caudal, 12 precaudal, and 24 total vertebrae in all four specimens.

The general body form of istiophorids changes with growth. Because all four specimens of *georgei* are of nearly the same size, the description below will apply only to adults. Juveniles and earlier life stages are unknown.

The dorsal profile is concave above the posterior part of the head, the nape being moderately humped. Exclusive of the sheath for the spinous dorsal fin, the dorsal and ventral profiles are nearly parallel. Behind this point the body narrows rapidly to the caudal peduncle. The general body form is best seen in Figure 1.

The body is fairly robust, being proportionally wider at the pectoral and first anal fin than *T. belone* and nearly equal to *T. albidus* in this regard.

The dorsal fin is moderately high posteriorly, its height at the 25th spine varying widely from 5.0-9.2 percent of total length. This is comparable to that of *T. belone* at the same size and higher than in *albidus*. The anterior lobe of the spinous dorsal fin is high (18-24 percent body length) and broadly rounded; likewise the first anal fin is high (12-15 percent body length) and broadly rounded. The dorsal fin is completely unspotted. This feature was checked especially on the sheathed portion of the fin where spots will persist even after severe treatment of sun drying, freezing, or preservative. In this regard *georgei* is similar to *pfluegeri*, *belone*, and *angustirostris*. None of the specimens exhibited bars on the body but these would have disappeared in the frozen specimens, so this condition is uncertain. However, neither *belone* nor *pfluegeri* is barred.

In istiophorids the pectoral fin usually is allometric in growth, sometimes, as in *pfluegeri* and *audax*, changing very rapidly from a short fin to long fin condition in a short size range. This fin is long in *georgei*, but the time or size of changeover is unknown. Presumably juveniles will have short pectoral fins.

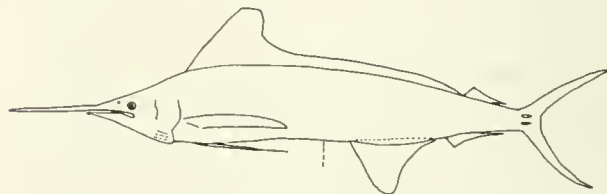


Figure 1.—Outline drawing of *Tetrapturus georgei* based on three photographs taken by Raimondo Sara of a specimen caught off Messina, Sicily, 1961, and with reference to measurements of other specimens (vertical dashed line indicates position of anus).



Table 1.—Comparison of four Atlantic species of *Tetrapturus* based on the most diagnostic characters.

Character	<i>Tetrapturus pfluegeri</i> Longbill spearfish	<i>Tetrapturus belone</i> Mediterranean spearfish	<i>Tetrapturus georgei</i> Roundscale spearfish	<i>Tetrapturus albidus</i> White marlin
Position of anus	Far anterior to anal-fin origin, the distance between them 8.4-11 percent body length and usually greater than height of first anal fin.	Far anterior to anal-fin origin, the distance between them 7.8-11 percent body length and equal to or exceeding height of first anal fin.	Moderately far anterior to anal-fin origin, the distance between them 4.8-7.6 percent body length and about half height of first anal fin	Close to anal-fin origin, the distance between them 3.3-5.2 percent body length and about one quarter the height of first anal fin
Lobes of first dorsal and anal fins	Pointed (the dorsal slightly rounded in large adults)	Pointed	Rounded	Rounded
Pattern of first dorsal fin	Unspotted	Unspotted	Unspotted	With numerous bluish black spots
Scales along mid-side in adults	Pointed, pungent	Pointed, pungent	Rounded with few large posterior points, soft	Pointed, pungent
Pectoral-fin length in adults	Long, subequal to pelvic fins, reaching beyond curve of lateral line	Short, even in adults, barely reaching curve of lateral line	Long, subequal to pelvic fins, reaching beyond curve of lateral line	Long, subequal to pelvic fins reaching beyond curve of lateral line
Orbit diameter (in percent of body length)	2.4-2.9	2.4-3.0	2.9	3.1-3.4
First dorsal fin elements	45-53 (usually 48-51)	39-46 (usually 42-45)	43-48	38-45 (usually 40-43)

Table 2.—Morphometric data for three specimens<sup>1</sup> of *Tetrapturus georgei* expressed in millimeters and in percentage of body length. Measurements are as defined by Rivas (1956) unless otherwise indicated. Numbers in parentheses refer to the numbered definitions of Rivas; see Robins and de Sylva, 1960:384-385 for explanation of abbreviations.

Specimen number	EAtl-3		EAtl-1		Med-1		Specimen number	EAtl-3		EAtl-1		Med-1	
Body length(1)	1540		1570		1600		Width at A <sub>2</sub> orig. (20)	92	6.0	90	5.7	91	5.7
First predorsal length (3)	360	23	346	22	360	22	Width cp (in front of keels)	54	3.5	45	2.9	40.5	2.5
Second predorsal length (4)	—	—	1,270	81	1,295	81	Length upper keel (22)	58	3.8	41	2.6	53.5	3.3
Prepectoral length (5)	412	27	393	25	390	24	Length lower keel (23)	53	3.4	51	3.2	49	3.1
Prepelvic length (6)	440	29	425	27	420	26	Head length (24)	414	27	385	24	385	24
First preanal length (7)	915	59	950	60	940	59	Snout length (25)	208	14	185	12	188	12
Second preanal length (8)	1,235	80	1,242	79	1,280	80	Bill length (26)	484	31	—	—	—	—
Orig. D <sub>1</sub> to orig. P <sub>1</sub> (9)	212	14	170	11	172	10	Maxillary length (28)	265	17	243	16	240	15
Orig. D <sub>1</sub> to orig. P <sub>2</sub> (10)	270	18	232	15	235	15	Orbit diameter (29)	45	2.9	46	2.9	46	2.9
Orig. D <sub>2</sub> to orig. A <sub>2</sub> (11)	153	9.9	145	9.2	147	9.2	Depth of bill (33)	15.4	1.00	12.8	0.82	—	—
Tip mandible to anus	856	56	825	52	830	52	Width of bill (34)	22.4	1.4	22.0	1.4	—	—
Orig. P <sub>2</sub> to nape (13)	260	17	238	15	245	15	Height D <sub>1</sub> (39)	371	24	274	18	285	18
Greatest body depth (14)	275	18	231	15	240	15	Length 25th D <sub>1</sub> spine (40)	141	9.2	78	5.0	92	5.8
Depth at orig. D <sub>1</sub> (15)	258	17	216	14	222	14	Height D <sub>2</sub> (41)	67	4.4	69	4.4	61	3.8
Depth at orig. A <sub>1</sub> (16)	220	14	205	13	210	13	Height A <sub>1</sub> (42)	236	15	190	12	210	13
Least depth cp (17)	66	4.3	54	3.4	60	3.8	Height A <sub>2</sub> (43)	51	3.3	—	—	48	3.0
Width at P <sub>1</sub> base (18)	115	7.5	96	6.1	110	6.9	Length P <sub>1</sub> (44)	405	26	—	—	330	21
Width at A <sub>1</sub> orig. (19)	125	8.1	113	7.2	122	7.6	Length P <sub>2</sub> (45)	328	21	—	—	344	22
							Length last D <sub>2</sub> ray	107	6.9	105	6.7	—	—
							Length last A <sub>2</sub> ray	92	6.0	97	6.2	82	5.1
							Orig. D <sub>1</sub> to orig. D <sub>2</sub>	910	59	936	60	930	58
							Anus to orig. A <sub>1</sub>	74	4.8	120	7.6	112	7.0
							Weight (kg)	23.5		20		21.5	

<sup>1</sup>The fourth specimen, EAtl-2, was damaged and no measurements were taken.

Flesh color is of uncertain value in istiophorid taxonomy but does reflect differences in myoglobin content. In *T. georgei* the flesh is distinctly redder than in *belone* and more like *T. albidus*.

Perhaps the most diagnostic feature of *georgei* is its lateral squamation. An area 100 × 100 mm is illustrated in Figure 2. Dorsal and ventral to this area, the scales are more elongate, stiffer, and with only one point or two closely approximated points. The lateral scales are softer and more flexible than in all other istiophorids. In counting vertebrae, the au-

thor makes a slit along one side to expose the centra. In running one's hand along this section, one always moves from front to back to avoid the very sharp posterior spine of istiophorid scales. The soft scales of *georgei* offer no such danger.

The lateral line is simple as in all species of *Tetrapturus*.

*Relationships.* *T. georgei* most resembles the white marlin, *T. albidus*. This is due largely to the somewhat humped nape and the broadly rounded anterior lobes of the first dorsal and anal fins.

Beyond that, however, comparison of the data in Table 2 with those presented by Robins (1974) for white marlin from the eastern Atlantic reveals differences only in four features: the width at the second anal fin (less in *georgei*), the orbit diameter (less in *georgei*), the length of the 25th dorsal spine, a measure of the posterior height of the fin (greater in *georgei*), and the distance from the anus to anal fin (greater in *georgei*).

The discovery of *georgei* makes more complete the transition between *Tetrapturus albidus* and *T. audax* on the one hand, called marlins because of their form and size, and the smaller species of spearfish, *T. belone*, *T. angustirostris*, and *T. pfluegeri*. Structurally, and in reference to the dendrogram in Robins and de Sylva (1960: Fig. 5), both *pfluegeri* and *georgei* would fall between *T. belone* and *T. albidus*. There is thus no clear division of the genus and no basis for recognizing as distinct subgenera *Tetrapturus* and *Kajikia*.

The continued placement of *albidus* in *Makaira* by Ovchinnikov (1970) is unexplained and naive. Likewise Ovchinnikov's distribution of *T. belone* is confused with *pfluegeri*, and his inclusion of *georgei* as a synonym of *belone* is incorrect.

**Distribution.** *Tetrapturus georgei* is positively known only from the specimens reported on here from Sicily, the Strait of Gibraltar, and the adjacent Atlantic Ocean off southern Portugal. Its occurrence at Madeira is inferred by application of the name *georgei*. Obviously this species can be expected to range widely in the eastern and perhaps central north Atlantic. Many of the records of *Tetrapturus pfluegeri* from these regions may be of *georgei*. Clarification of the central and eastern Atlantic records of spearfish from Japanese data (Ueyanagi et al., 1970) is of vital importance. The larvae and juveniles and their areas of occurrence are unknown. Data are too few to permit discussion of seasonal or annual variation in occurrence beyond the point that all istiophorids reaching Madeira and the southern coasts of Portugal and Spain do so during the warm months and that a movement south and west during the cold season may be assumed.

**Hybridization.** Hybrids in fishes are usually intermediate in characters most often used by systematists (i.e., fin-ray counts, body proportions) because these characters apparently are polygenic and the genes pleiotropic. This has been frequently discussed but perhaps nowhere more clearly than by Hubbs (1940:205-207; 1943). Whenever a rare species occurs which is intermediate in its characters

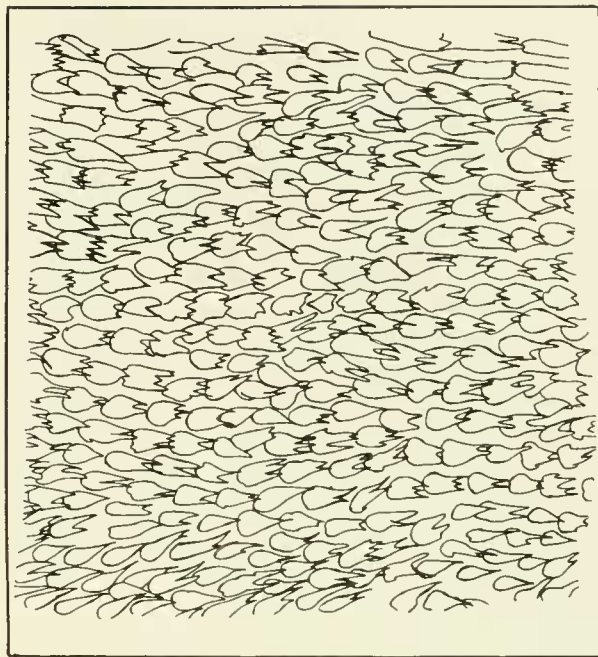


Figure 2.—Squamation of *Tetrapturus georgei*, patch 100 × 100 mm from right side below spinous dorsal fin. Drawing by Charles D. Getter.

between two more common species, there are a priori grounds for believing it to be based on hybrids between the two. Natural hybrids in fishes are most common among freshwater species where man's alteration of the environment has resulted in breakdown of ecological barriers. Hybrids are rarer among coastal fishes, rarer still in the stable environment of the tropical reefs, and unknown among truly oceanic fishes. Hybridization in a long established pelagic family like the Istiophoridae would seem to be highly unlikely.

Two possible hybrid combinations were considered in analyzing the characters of *georgei*: 1) *Tetrapturus albidus* × *T. belone*, and 2) *T. albidus* × *T. pfluegeri*. Analysis of Table 1 shows that *T. georgei* is intermediate in several of its most diagnostic characters between *T. albidus* and both *pfluegeri* and *belone*, namely the position of the anus and the diameter of its orbit. Its squamation is unique and the shape of its dorsal- and anal-fin lobes are as in *albidus*. Additional data for *pfluegeri* are available in Robins and de Sylva (1960, 1963) for *belone* in Robins and de Sylva (1963) and for *albidus* in Robins (1974). In the height of its first dorsal and anal fins, *georgei* is as extreme as *albidus*. In short, no good case can be made to consider *georgei* to be based on hybrids. Also, available evidence on



spawning grounds of *belone* and *albidus* indicates that these species are at least 2,000 miles apart at spawning time. *T. albidus* and *T. pfluegeri* broadly overlap geographically, but whether *georgei* occurs in the western Atlantic is unclear.

Fishermen, particularly those working in the Gulf of Mexico, have described a fish they term a hatchet marlin in reference to the high and squarish anterior lobe of its dorsal fin. D.P. de Sylva has discussed this fish at this conference and has shown color slides provided by Robert Ewing of Monroe, Louisiana. I have also studied a series of black and white negatives of this fish. The shape of the first dorsal is dramatically like that in *georgei* (see Figure 1) and the scales appear large and rounded. However, the spinous dorsal and first anal fins appear much higher in the fish from the Gulf of Mexico. Certainly it appears that the hatchet marlin and the roundscale spearfish are closely related, if not identical, but no specimens of the former have ever been studied by scientists, and among contemporary biologists, only the writer has seen specimens of *georgei*. This species needs publicity in game-fish circles, with arrangements made to freeze specimens and bring them to the attention of appropriate scientists for study. This also calls attention to the growing need to provide contingency funds to preserve and ship such specimens, or to provide travel funds for scientists to the specimens when such rarities are caught by anglers.

*Reproduction.* All three of the known females were in a refractory state with no developed ova. They were collected 27 May, 9 August and 5 October. All were adults and this slim evidence may be taken to indicate that in *georgei*, like its Atlantic congeners, spawning is over by early summer. The only male, collected 2 August, still had fairly large testes but was not in spawning condition.

Nothing else is known of the bionomics and life history of the species.

An additional species of *Tetrapturus* is shown to exist in the northeastern part of the Atlantic Ocean and in the Mediterranean Sea. The name *Tetrapturus georgei* Lowe, previously regarded as unidentifiable, is applied to this species. The nomenclature is discussed in detail, and reasons for so restricting and applying this name are given.

The species is described on the basis of study of three females and one male, all adults. Morphometric data are available for three, one having been mutilated in a way that such data were unusable. *T. georgei* is contrasted with the other Atlantic species

of *Tetrapturus*: *T. belone*, *T. pfluegeri*, and *T. albidus*.

The possibility that the specimens of *georgei* represent hybrids between other species is discussed and rejected.

Known information on distribution and reproduction are summarized.

## ACKNOWLEDGMENTS

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## LITERATURE CITED

- ALBUQUERQUE, R.M.  
1956. Peixes de Portugal e ilhas adjacentes. Port. Acta Biol. Ser. B 5:1-xvi+1-1164, 445 figs.
- BAILEY, R.M., J.E. FITCH, E.S. HERALD, E.A. LACHER, C.C. LINDSEY, C.R. ROBINS, and W.B. SCOTT.  
1970. A list of common and scientific names of fishes from the United States and Canada (third edition). Am. Fish. Soc., Spec. Publ. 6, 149 p.
- CUVIER, G., and A. VALENCIENNES.  
1831. Histoire Naturelle des Poissons. Paris 8:i-xix, 1-509.
- HUBBS, C.L.  
1940. Speciation of fishes. Am. Nat. 74:198-211.  
1943. Criteria for subspecies, species and genera, as determined by researchers on fishes. Ann. N.Y. Acad. Sci. 44:109-121.
- LOWE, R.T.  
1840. On new species of fishes from Madeira. Proc. Zool. Soc. Lond. 8:36-39.  
1841. Description of some new species of Madeiran fishes, with additional information relating to those already described. Ann. Mag. Nat. Hist., Ser. 1, Vol. 7:92-94.  
1849. Supplement to "A synopsis of the fishes of Maderia". Trans. Zool. Soc. Lond. 3:1-20.
- OVCHINNIKOV, V.V.  
1970. Swordfish and billfishes in the Atlantic Ocean. Ecology and functional morphology. Atl. Sci. Res. Inst. Fish. Oceanogr., 77 p. (Translated by Israel Program Sci. Transl., 1971, 77 p; available U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, VA, as TT71-50011.)
- RAFINESQUE, C.S.  
1810. Caratteri di alcuni nuovi generi e nuove specie di ani-

- mali e piante della Sicilia. Palermo, 105 p., 20 pls.
- RIVAS, L.R.  
1956. Definitions and methods of measuring and counting in the billfishes (Istiophoridae, Xiphiidae). Bull. Mar. Sci. Gulf Caribb. 6:18-27.
- ROBINS, C.R.  
1974. Summer concentration of the white marlin, *Tetrapturus albidus*, west of the Straits of Gibraltar. In Richard S. Shomura and Francis Williams (editors), Proceedings of the International Billfish Symposium, Kailua-Kona, Hawaii, 8-12 August 1972, Part 2. Review and Contributed Papers. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-675, p. 164-174.
- ROBINS, C.R., and D.P. DE SYLVA.  
1960. Description and relationships of the longbill spearfish, *Tetrapturus belone*, based on the western North Atlantic specimens. Bull. Mar. Sci. Gulf Caribb. 10:383-413.
1963. A new western Atlantic spearfish, *Tetrapturus pfluegeri*, with a redescription of the Mediterranean spearfish *Tetrapturus belone*. Bull. Mar. Sci. Gulf Caribb. 13:84-122.
- RODRIGUEZ-RODA, J., and J.K. HOWARD.  
1962. Presence of Istiophoridae along the South Atlantic and Mediterranean coasts of Spain. Nature (Lond.) 196:495-496.
- UEYANAGI, S., S. KIKAWA, M. UTO, and Y. NISHIKAWA.  
1970. Distribution, spawning, and relative abundance of billfishes in the Atlantic Ocean. Bull. Far Seas Fish. Res. Lab. (Shimizu) 3:15-55.